FROM FANNIE

Southern Pine BEETLE NEWS

U.S.D.A. SOUTHERN PINE BEETLE RESEARCH & APPLICATIONS PROGRAM

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Sampling Effort Optimized

As a prerequisite to compiling full-scale beetle population data, optimum sample size and number have been determined. Also, a procedure has been outlined for estimating both density of the bark beetle and its natural enemy populations throughout an infested area in southern Arkansas.

Efforts to devise sampling systems for population dynamics studies have usually been directed at a life stage or stages of the bark beetle. Generally, they have not considered sampling requirements for their natural enemies — the parasite complex and predator complex.

Optimum size was developed as a function of the variables to be measured: attack density, gallery length, total brood, parasite complex and predator complex. A series of permanent 2000 cm^2 x-ray maps were made and stored in a computer. Programs were then written by randomly selecting a series of defined experimental sample unit sizes. This effort should provide reliable information needed for an evaluation of critical mortality factors.

STEPHEN, F. M. and H. A. TAHA.

1976. Optimization of sampling effort for within-tree populations of southern pine beetle and its natural enemies. Environ. Entomol. 5 (5): 1001-1007.

Engineering Offers Solution To Population Research

Engineering methods are now being used to evaluate within-tree beetle populations. A production flow system developed for electrical engineering problem solving offers an alternative to the traditional life table format, and its most important advantage is that variables are tied together mathematically and cast into a formal engineering mold. It is not, however, suitable for describing the dynamics of populations.

With this system it is possible to quantitatively define within-tree populations of the various life stages. Basically, the system is a representation of life stages within a generation and an account of mortality between stages. Between-stage mortality varied within the three years of the study, but followed the same general pattern. Greatest mortality occurred between the egg and late larval stages.

COULSON, ROBERT N. et al.

1976. Production flow system evaluation of within-tree populations of *Dendroctonus frontalis*. Environ. Entomol. 5 (3): 375-387.

Sampling Methods Covered At November Workshop

An insect sampling workshop was held in Atlanta on November 3-4, 1976, to discuss accomplishments and future work. Topics included all areas of sampling, plans for modeling, and the need for cooperation among projects.

The initial discussion was on the Texas A&M within-tree sampling techniques, their applicability to various geographic areas, and modifications or alternatives. As the principal investigators presented their methods, it became apparent that objectives differed. Some were more concerned with developing methods while others wanted a direct approach for field use. Also, there were regional differences in both the specifics of sampling and the amount of sampling needed.

The group agreed that standardization is needed for a system to be valid across the South. The TAMU group considered their procedures adequate for describing within-tree populations throughout the South if trees are between 10 and 20 inches dbh, are under attack for a short time, and are sampled during the growing season.

It was felt, however, that more factors would have to be considered before relating populations to damage and treatment. Populations would have to be listed by life stages in different trees and trends would have to be estimated as they related to potential damage.

In a discussion of sampling within-infestation and area populations, it was again found that different

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projects had different approaches. It was decided, however, that enough experience and data are now available to proceed with estimating such populations.

Computer Offers Simulation Of Natural Tree Growth

Growth of loblolly pine plantations under various management alternatives can be modeled with a FORTRAN programmed computer, with individual trees as the basic growth units. This simulator is more flexible than stand-level models for growth and yield estimates and for evaluating alternative management practices.

In PTAEDA, trees are "grown" as a function of their size, site quality, and competition with neighboring trees. Natural variables are therefore dealt with in a logical and natural fashion rather than ignored. Subroutines simulate the effects of site preparation, thinning, and fertilization on tree and stand development.

Since size and location of individual trees are known, the model is useful to studies where spatial input is important. The model makes it possible to study various insect and disease patterns and to determine the effectiveness of control programs.

DANIELS, R. F. and H. E. BURKHART.

1975. Simulation of individual tree growth and stand development in managed loblolly pine plantations. Va. Polytech. Inst. & State Univ., Blacksburg, FWS-5-75. 69 p.

Area-Wide Survey Suggests Common Host and Site Factors

Measurements in an 85,000-acre area in east Texas suggest that attacked trees have larger than average diameters and occur in denser, purer pine stands. The area was systematically surveyed and all detected infestations were measured — 4956 trees on 477 beetle spots. Diameter and merchantable height estimates were listed for each tree.

Drainage and soil classification data did not support the theory that most attacks occur on heavier soils, such as clay, with poor drainage. Most spots were on fairly moist sandy loam soils with good drainage.

Height comparisons were difficult, but measurements were listed for future reference. Also, it was difficult to determine a basal area susceptibility threshold because of the dependence on site quality. But 30 percent of the infestation occurred where basal area was greater than 120 square feet. Seventy-five percent of the spots had 5 or less trees, but the 8 largest spots contained 37 percent of the affected trees. This underscored the importance of keeping spots small if the management objective is to minimize forest loss.

LEUSCHNER, W. A. et al.

1976. A descriptive study of host and site variables associated with the occurrence of *Dendroctonus frontalis* Zimm. in east Texas. Southwest. Entomol. 1 (3): 141-149.

Mathematical Modeling Offers Passport To Future Beetle Sampling Work

Mathematical modeling is essential to an understanding of population dynamics. Probability density functions (PDFs) have now been derived for the within-tree life stages of the southern pine beetle. It is hoped that these models can be used to define known aspects of the population in precise mathematical terms and also to predict new aspects.

Since *D. frontalis* forms an integrated system of structures and functions essential to its ability to reproduce its own kind, data were taken on attack density, gallery length, eggs, larvae,. and number of emerging adults. Subsequent analyses were based on bark disks taken from various heights. This yielded relationships between the variables as functions of the infested bole height.

The possible existence of a negative feedback mechanism that lets the beetle make optimum use of available resources is proposed. Also, a concept is advanced for optimum location on the bole where environmental conditions allow maximum beetle survival.

MAYYASI, A. M. et al.

1976. Mathematical description of within-tree distributions of the various developmental stages of *Dendroctonus frontalis* Zimm. Res. on Popul. Ecol. 18 (1): 135-145.

Advances in Modeling Cited For Beetle Research

It is possible to model tree diameter and bark thickness, combine these models to estimate infested surface area and bark volume, and apply the models to beetle population dynamics.

A simple and tractable model was developed for outside-the-bark diameter (dob). Previous models seemed to overestimate or underestimate dob at different places on the tree. But this model is confined to the lower portion of the tree and is sufficiently accurate. A simplified bark thickness model proved

effective to a height of 1100 cm, the highest infestation on two-thirds of the sample trees.

A phloem area model also proved effective and is useful for estimating the total number of beetles in an infested tree. The bark volume model gives good estimates for sections from 137 to 1100 cm although total infested volume is slightly underestimated.

These models suggest that bark volume is not a critical resource for the beetle, although it might be important for the protection it offers against weather and predators.

FOLTZ, J. L. et al.

1976. Host-tree geometric models for use in southern pine beetle population studies. Environ. Entomol. 5 (4): 714-719.

NEW RESEARCH FUNDED

Two insecticide field experiment studies have been funded to see if 1- and 2-percent concentrations of chlorpyrifos and chlorpyrifos-methyl are equally or more effective than 0.5 percent lindane water emulsion for preventing attacks. In each study, six different treatments will be tested and success will be judged by death or survival of standing study trees. Investigators are C. W. Berisford and U. E. Brady, Department of Entomology, University of Georgia, and J. Lashomb and W. W. Neel, Department of Entomology, Mississippi State University.

A new study will determine if adequate historical beetle incidence and climatic data exist in several geographic areas as a first step in relating climatic variables to beetle outbreaks. If adequate data are available, a second phase of the study will relate selected climatic variables to the number and/or severity of infestations in the southeastern states. Investigators are J. B. Campbell and K. E. Smith, Department of Geography, Virginia Polytechnic Institute and State University.

Another new investigation will determine the effect of salvage operations on spot growth and proliferation. Results will be used to refine salvage control guidelines and the associated cost/benefit. This will provide a comparison for other suppression tactics. Investigators are G. D. Hertel, W. H. Clerke, R. J. Uhler, and C. R. Stein, Southeastern Area, State and Private Forestry.

In a fifth study, population trend prediction techniques developed and tested in North Carolina and Virginia will be further evaluated there and tested in either Louisiana or Texas. The study will determine if infestation spot growth or collapse can be accurately predicted several months in advance, using the attack/emergence ratio, and whether or not the methods used are equally effective in mid-Atlantic and west Gulf Coastal States. Infestations will be monitored for one year in each geographic area to verify the accuracy of the predictive techniques. Investigators are G. E. Moore, Southeastern Area, State and Private Forestry, and J. Ghent, Southeastern Forest Experiment Station.

Tree Growth Influenced By Root Infection

Incidence and severity of *Fomitopsis annosa* infection has been determined on 14 plots of loblolly pine in Virginia. Each plot had 25 trees and was established between 30 and 100 meters from an identified source of infection. A bulldozer was used for excavation and the root systems were visually estimated for evidence of infection.

Thirty-five percent of the trees were infected, averaging 30 percent for primary roots and 31 percent for secondary roots. The average length of roots infected was 14 and 15 percent respectively.

From cross-sectional disks extracted at 1.4 meters, it was determined that trees on several plots had less growth where infection was high.

A related study (reported in newsletter 7) indicates that severe infection by *F. annosa* causes a reduction in growth and vigor and may predispose trees to bark-beetle attack.

BRADFORD, B. and J. M. SKELLY.

1976. Levels of *Fomitopsis annosa:* influence on growth. Proc. Southwide For. Dis. Workshop, Atlanta, Ga. June 15-17, 1976. USDA For. Serv. Southeast. Area, S&PF. 1 p.

Behavioral Chemical Research Discussed

At the behavioral chemicals workshop held last March in Nacogdoches, Texas, it was decided that additional isolation and identification of the candidate compounds will be needed. This includes resolving questions about the activity of certain pheromone extracts known to contain frontalin, and the possible activity of two recently identified compounds.

Further discussion centered around strategies for field testing. Sleeve olfactometers will be used to determine field activity of several behavioral chemicals because this method may test small amounts of materials more effectively than the sticky traps now being used.

Area-wide field testing will first employ the inhibitor brevicomin, since inhibitors seem to offer better initial success from a behavioral standpoint.

When one or two of the most promising compounds have been identified, and when use patterns have been defined, efforts toward registration will begin.

Investigators Combine Efforts At Integration Workshop

Underscoring the interdisciplinary nature of the Southern Pine Beetle Program, site/stand and population dynamics investigators met in Atlanta last February for an integration workshop.

The groups are combining efforts to better develop the Program's prediction models. Site/stand work relates beetle frequency and intensity to site and stand characteristics, constructs models to rank stands by susceptibility class, and recommends silvicultural practices to minimize loss. Beetle population dynamics is important in these objectives, especially in the model that predicts spot growth if the spot is left uncontrolled. Population information is also needed for the wide-area model that predicts damage for the following month.

Population investigators will bait stands with known population numbers and monitor spread throughout the summer. These studies will be in stands with characteristics that would make the findings most useful in developing models needed by the Program.

Workshop participants recognized the need to know what starts an outbreak, including important climatic conditions. Also, it was noted that the time factor has been missing in research. Observations are therefore needed over time on the same spot, beginning with spot initiation.

Beetles and Sawyers Compete In Early Developmental Stage

Competition between the southern pine beetle and the sawyer *Monochamus titillator* has been demonstrated experimentally. Models have been developed to describe insect competition and influence.

Competition is defined as the adverse influence exerted on beetle survival by the sawyer through the sawyer's demands for food and space. Female sawyers respond to pines that are being attacked by beetles, and oviposition by the two species occurs concurrently.

Larval development occurs simultaneously in the inner-bark region and both species use this area for food and habitat. In the late-larval stages, beetles move into the outer bark and sawyers move into the xylem.

Competition therefore occurs during the inner-bark developmental stages. The sawyer, a larger and more mobile insect, has the greater ability to use the inner bark region.

COULSON, R. N. et al.

1976. Interspecific competition between *Monochamus titillator* and *Dendroctonus frontalis*. Environ. Entomol. 5 (2): 235-247.

OTHER PUBLICATIONS OF INTEREST

Daniels, R. F.

1976. Simple competition indices and their correlation with annual loblolly pine tree growth. For. Sci. 22 (4): 454-456.

Stewart, T. E. et al.

1977. Determination of enantiomer composition of several bicyclic ketal insect pheromone components. J. Chem. Ecol. 3 (1): 27-43.

Thatcher, R. C.

1977. Status of the expanded pine beetle research program. Forest Farmer 36 (6): 8-9.

Stultz, S. C.

1977. Woodpeckers found helpful in southern pine beetle control. Forest Farmer 36 (6): 9.

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